



Evaluation # 200304-N (Replaces 970053-N)

Safety & Buildings Division
201 West Washington Avenue
P.O. Box 2658
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Wisconsin Building Products Evaluation

Material

Metal Connector
Trade Names: Alpine, Trulox, K and Wave Plate™

Manufacturer

Alpine Engineered Products, Inc.
1950 Marley Drive
Haines City, FL 33844

SCOPE OF EVALUATION

GENERAL: This report evaluates Alpine HS (20 gauge), Wave Plate™ (20 gauge), K (16 gauge) –LM K, Trulox Nail (20 gauge), and Alpine 2 x 8 Hinge (20 gauge) –HP 28 metal connector plates for wood trusses, manufactured by Alpine Engineered Products, Inc.

This review includes the cited **Comm** code requirements below in accordance with the current **Wisconsin Uniform Dwelling Code for 1 & 2 family dwellings (UDC):**

- **Allowable Stress Design:** Alpine HS (20 gauge), Wave Plate™ (20 gauge), K (16 gauge) –LM K, Trulox Nail (20 gauge), and Alpine 2 x 8 Hinge (20 gauge) –HP 28 metal connector plates for wood trusses, were evaluated for use within allowable design values in accordance with **s. Comm 21.02(3)** and standards adopted under **s. Comm 20.24 (17)**.

This review includes the cited **International Building Code (IBC)** requirements below in accordance with the current **Wisconsin Amended IBC Code:**

- **Allowable Stress Design:** Alpine HS (20 gauge), Wave Plate™ (20 gauge), K (16 gauge) –LM K, Trulox Nail (20 gauge), and Alpine 2 x 8 Hinge (20 gauge) –HP 28 metal connector plates for wood trusses were evaluated for use within allowable design values in accordance with **s. IBC 2306.1** and **s. IBC 2308.10.7.1**.

DESCRIPTION AND USE

GENERAL: The Alpine HS (20 gauge), Wave Plate™ (20 gauge), K (16 gauge) –LM K, Trulox Nail (20 gauge), and Alpine 2 x 8 Hinge (20 gauge) –HP 28 metal connector plates are used in wood trusses as a means of joining together wood members at joints. All products other than the Trulox plate can be used without nails where truss members are held by jigs. Plates are embedded on both faces of each joint by roller or hydraulic press.

Alpine HS: is stamped from 20 gauge galvanized steel meeting the minimum requirements of ASTM A653 HSLA Grade 60 with minimum elongation of 20 per cent in 2.0-inches with an ASTM A653 G60 coating. Two opposing 0.327-inch long by 0.115-inch wide concave, pointed teeth are punched from each 0.49-inch long by 0.115-inch wide slot in the parent metal. The slots are spaced 0.875-inches on center longitudinally and in staggered rows 0.3125-inches on center across the plate width. Adjacent rows are staggered 0.4375-inches. The rows of slots in groups of 4, each group being separated by a 0.0625-inch wide longitudinal embossment. There are 6.97 teeth per square inch of plate. Plate sizes range from 2.625- by 7-inches to 13.125- by 24.5-inches.

Wave Plate™: is made from ASTM A 653-94 SQ Grade 40 steel with a G60 galvanized coating and a minimum thickness of 0.0356-inches (20 gauge). Slots that are 0.12-inch wide and 0.500-inch long are aligned parallel to the plate length and spaced at 0.25-inch on center across the width of the plate and 1.00 inch on center along the length of the plate. Adjacent slots are staggered 0.060-inches along the length of the plate from each other in a double alternating pattern, resulting in three slot positions: centered in the row, +0.060 in from the center of the row and – 0.060 in from the center of the row, giving an undulating or “wave” pattern within each row of slots. Two 3/8-inch long teeth are punched from each slot. The Wave Plate™ is available in 1-inch increments of both width and length, where the first number indicates the width and the second number indicates the length, in units of inches. Wave Plates™ are identified by the unique double-offset slot pattern.

Alpine K -LM K: is stamped from 16 gauge galvanized steel meeting the minimum requirements of ASTM A653 SQ Grade 33, or better, with an ASTM A653 G60 coating. Two opposing 0.135-inch wide concave, pointed teeth averaging 0.275-inches long are punched from each 0.54-inch long by 0.135-inch wide slot in the parent metal. The slots are spaced 1.3125 inches on center longitudinally and in staggered rows spaced 0.333 inches on center across the plate width leaving 4.57 teeth per square inch of plate. Adjacent rows are staggered 0.25-inches. Plate sizes range from 1- by 1.3125-inch to 12- by 23.625-inches.

Trulox Nail Plate: is formed from 20 gauge galvanized steel by punching out circular holes for separately applied nails. Holes are spaced 2-inches on center in rows running lengthwise of the plate. Rows of holes are 0.333-inches on center across the plate width, with every other row staggered 1-inch along the plate length, causing the holes to form a zigzag pattern. There are 1.5 holes per square inch of plate. The holes are 0.131-inch in diameter.

Alpine 2 x 8 Hinge Plate –HP28: is stamped from 20 gauge galvanized steel meeting the minimum requirements of ASTM A653 SQ Grade 33, or better, with an ASTM A653 G60 coating. Two 2-inch by 4.5-inch metal plates are overlapped by 1-inch, then grommetted together with a brass grommet through a punched hole in each plate. For each side of the hinged plate, three rows of 8 pairs of teeth per row are punched perpendicular to the plane of the plate, each pair leaving a 0.10-inch by 0.60-inch slot in the plate. The slots are spaced 1-inch apart on center longitudinally and the rows spaced 0.25-inches apart across the plate width, leaving 48 teeth on each side of the hinge, or a total of 96 teeth per hinge plate. Each slot is offset along its length 0.12-inches from the adjacent slots. Teeth are 0.10-inch wide by 0.36-inch long, pointed on the end and v-shaped in cross-section. The plates are designed to be used with a 1-inch gap between the wood members, to allow for rotation of one of the members.

TEST AND RESULTS

The tests and results below are in accordance with both the **Wisconsin Uniform Dwelling Code (UDC)**, and the **Wisconsin Code** for commercial and multi-family dwellings:

Tests were conducted to evaluate the lateral resistance design values of the 16- & 20-gauge metal plate connectors for two different species of wood: Southern Yellow and Spruce Pine Fir, in accordance with the ANSI/TPI-95. The Gross Area Method described in ANSI/TPI-95 was used to determine the plate holding values.

The lateral resistance values must be reduced by the percentage listed in TPI-95, Design Specifications for Metal Plate Connected Wood Trusses (section 5.11.1.3), at various joint locations and in accordance with good engineering practices as may be necessitated by minimum plate size and handling and shipping procedures.

Tests on the Wave™, Alpine HS, Alpine K, and Alpine 2 x 8 20 gauge Hinged Plate, metal connector plates lateral resistance values, tension and shear efficiency factors resulted in the design values shown in the following tables. Test reports are on file with the department.

ALLOWABLE DESIGN VALUES

EFFECTIVE SHEAR RESISTANCE RATIO

(pli) to be calculated in accordance with TPI-95 section A.7.2.11

Plate Orientation	Plate Type		
	Alpine HS	LM K	Wave
0°	0.435	0.548	0.563
30°	0.720	0.515	0.739
60°	0.810	0.517	0.832
90°	0.517	0.562	0.487
120°	0.330	0.483	0.454
150°	0.412	0.472	0.477

LATERAL RESISTANCE VALUES

(psi) in accordance with TPI-85 App. C

Plate Type and Orientation (degrees)

Species	Alpine HS		LM K ²	
	0°	90°	0°	90°
Southern Pine	207	173	249	258
Douglas Fir	210	168	240	241
S-P-F	164	118	201	205
Hem - Fir	185	139	207	246
M' Plank-w³	153	109		
M' Plank-n³	123	87		
T' max-w³	202	154		
T' max-n³	161	120		

NOTES:

1. HS values are on a net area basis using an end distance of 0.44 inch for 0 degree orientation and 0.34 inch for 90 degree orientation.
2. K values are on a gross area basis.
3. M' Plank and T' max refer to laminated veneer lumbers (LVL) marketed as MasterPlank and Timbermax, respectively. The "w" and "n" designations refer to the face in which the teeth are embedded, with "w" meaning teeth embedded into the face showing a single ply of veneer (usually the wide face) and penetrating perpendicular to the veneers; and "n" meaning teeth embedded into the face showing edges of multiple plies of veneers (usually the narrow face) and penetrating parallel to the veneers. MasterPlank is manufactured from Norway spruce and distributed by McCausey Lumber Co. Timbermax is fabricated from Douglas-Fir by Tecton Laminates Corp. and distributed by Alpine Structures, Inc.

Wave Plate™ Lateral Resistance Values (psi)

Standard (Hydraulic) Values					Single-Pass Roller Values			
Lumber	AA P0G0	EA P90G0	AE P0G90	EE P90G90	AA P0G0	EA P90G0	AE P0G90	EE P90G90
GROSS AREA VALUES (0" end and edge distances)-----								
S. Pine	206	158	163	170	179	143	142	153
Doug. Fir	206	156	145	153	179	141	126	138
Hem-Fir	164	109	106	124	134	96.7	86.5	110
SPF	159	109	106	118	130	96.7	86.5	105
SEMI-NET AREA METHOD VALUES (1/2" end distance, 0" edge distance) -----								
S. Pine	275	195	163	170	239	177	142	153
Doug. Fir	275	195	145	153	239	177	126	138
Hem-Fir	208	134	106	124	170	119	86.5	110
SPF	208	130	106	118	170	115	86.5	105

TENSION EFFICIENCY VALUES

(pli) to be calculated in accordance with TPI-95 section A.7.3.10

Plate Orientation	Alpine HS	LM K	Wave
0°	0.709	0.591	0.512
90°	0.259	0.464	0.486

TRULOX NAIL PLATE

The Trulox nail plate is designed for separately applied nails with a diameter no greater than 0.131 inch. Design is based upon allowable nail design values.

ALPINE 2x8 20 gauge HINGE PLATE DESIGN VALUES (Pounds/Pair of Plates)

<u>Property</u>	<u>Design Load</u>
Tension	689 lbs
Compression	437 lbs
Shear	501 lbs

The plate holding values must be reduced by the percentages listed in the “Design Specification for Metal Plate Connected Wood Trusses, TPI-95”, as published by the Truss Plate Institute, at various joint locations and in accordance with good engineering practices as may be necessitated by minimum plate size and handling and shipping procedures.

LIMITATIONS OF APPROVAL

GENERAL: This approval is for the allowable design values of the metal connector plates and tension web only as specified in the manufacturer’s product catalog. It is not an approval for a truss or joist or a construction design.

Allowable loads are based on Douglas Fir (DF), Spruce (S-P-F), Hem-Fir, and Southern Yellow Pine (SYP) wood. The allowable load for other wood species must be adjusted according to the to the 1991 Edition of the National Design specification for Wood Construction.

The evaluation of the use of Alpine HS (20 gauge), Alpine, K (16 gauge) - LM K, Trulox Nail (20 gauge) , and Alpine 2 x 8 Hinge (20 gauge) - HP 28, metal connector plates with pressure or fire retardant treated lumber is beyond the scope of this approval.

Truss framing members shall be held in jigs during installation. The plates are inserted under pressure from a hydraulic press or roller press.

The metal connector plates and tension web must be installed according to the manufacturer’s installation requirements.

The limitations below are in accordance with both the **Wisconsin Uniform Dwelling Code (UDC)**, and the **Wisconsin Code** for commercial and multi-family dwellings or as noted:

This approval is for the allowable design values of the connector plates only and not an approval for a truss or joist or a construction design. See **TESTS AND RESULTS** section above for the allowable design values.

The connector plates have been designed in accordance with the procedures established by the Truss Plate Institute and the design specifications for light metal plate connected trusses. Truss designs must be made according to the specifications of the T.P.I.

The connector plates may be used to construct trusses in accordance with **ss. Comm 21.22 (2), 21.28 (5)** of the **Wisconsin Uniform Dwelling Code (UDC)**, and **s. IBC 2306.1** of the **Wisconsin Amended IBC 2000 Code**.

IDENTIFICATION: with the manufacturer's name and as follows:

embossed with the symbols: Alpine HS , Alpine , LM K ,

Wave and HP 28 permanently stamped on each plate
3-inches in width or wider and at least 25 per cent of
all plates that are less than 3-inches in width.

INFORMATION REQUIRED ON PLANS SUBMITTED

TRUSS PLAN SUBMITTAL REQUIREMENTS:

The approval number as well as the following information must be made a part of all truss plan submittals so that unnecessary delays will not result because of the lack of proper information.

1. Acceptable Unit Stresses. The allowable unit stresses published in the National Design Specifications For Wood Construction, including Design Values for Wood Construction, supplement to the Edition of the National Design Specification for Wood Construction, as recommended by the National Forest Products Association and its Supplement, shall be used to determine allowable unit stresses.
2. An increase in allowable bending stress due to repetitive member use is acceptable as listed in NDS Table 1 Supplement.
3. Moment coefficients used in design of top or bottom chord members shall be based on the assumption of no fixity at member end or joints due to plate connectors. Moment coefficients listed in ANSI/TPI-95 with appropriate panel length adjustment factors are to be used in the design of the trusses.
4. The cumulative effects of short-time loads, such as snow, shall be considered in determining the duration of the load. For snow load, no greater duration of load factor than 1.15 shall be used.
5. The metal plate connector must be properly identified on the plans. The gauge of metal plate and its design capacity (in pounds per nail or pounds per square inch) must be shown on the plans. Light gauge perforated metal plate connectors shall be permanently identified with regard to their gauge and manufacturer. If a manufacturer's code is used to identify the plates, the code shall be explained on the plans. The design and use of metal plate connectors shall be in accordance with the requirements of **s. IBC 2306.1**.
6. Drawings must be provided for all joints and splices (duplication of identical joints is not necessary). The drawings must clearly indicate the contributory number of nails or square inches of plate area required on each member of each joint.
7. A stress diagram (to scale or a function of "L") must be shown on the plans. An acceptable alternate would be to provide calculations using other methods of determining axial loads. Calculations may be placed on computer output sheets only if computer programs are provided with adequate explanation on request to the satisfaction of the department.
8. Calculations must be provided which analyze the combined effects of axial loads and bending moments on top and bottom cord members.
9. A framing plan must accompany the truss plans when several different trusses, bearing conditions and elevation changes occur.
10. All wood trusses shall be securely fastened to the supports and each truss shall be secured in position in accordance with National Design Specifications, Appendix A, Section A-10.
11. A title block must be provided on all submittals indicating the name of the owner, exact address of building and location of building. If there are several building on a lot, the trusses must be properly identified for location (this is not necessary for identical trusses).
12. All truss plans for buildings over 50,000 cubic feet in volume must be sealed or stamped and signed by an architect or professional engineer registered in Wisconsin. The intent is to have each sheet stamped, signed and dated by the engineer or architect responsible for the trusses. If the building designer is different than the truss designer the truss plans shall be submitted by the building designer with their initials, and a statement on the truss plans that, they are acceptable.
13. Wood trusses shall be designed and constructed in accordance with the National Design Standard For Metal Plate Connected Wood Truss Construction published by the Truss Plate Institute (ANSI/TPI-95) with listed exceptions as outlined above and stated in **s. IBC 2306.1**.
14. An examination fee per **s. Comm 2.31** may be required for each building submittal.

Any other information required by **s. Comm 61.31** shall also be submitted.

This approval will be valid through December 31, 2008, unless manufacturing modifications are made to the product or a re-examination is deemed necessary by the department. The Wisconsin Building Product Evaluation number must be provided when plans that include this product are submitted for review.

DISCLAIMER

The department is in no way endorsing or advertising this product. This approval addresses only the specified applications for the product and does not waive any code requirement not specified in this document.

Revision Date:

Approval Date: May 15, 2003

By: _____

Lee E. Finley, Jr.
Product & Material Review
Integrated Services Bureau

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